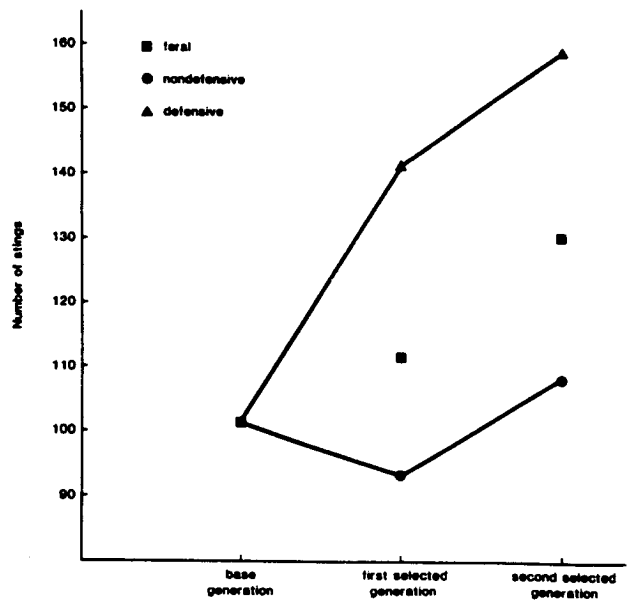
Proceedings of the American Bee Research Conference

The 1986 American Bee Research Conference was held at the Agricultural Center of Louisiana State University on October 7 and 8. A second conference will be held at the same place on October 6 and 7, 1987. Abstracts of the proceedings follow.

1. Collins, A. M.[a] — **BIDIRECTIONAL SELECTION FOR COLONY DEFENSE IN AFRICANIZED HONEY BEES** — The initial direction of this research was to determine the feasability of a genetic selection program to produce less defensive bees, and to carry out such a program using Africanized stocks. A field test of colony defensive behavior had been developed by Collins and Kubasek (*Ann. Entomol. Soc. Amer. 4:355*) to quantify aspects of the complex of behaviors that collectively constitute colony defense. Using this standard test, an array of colonies with appropriate genetic relationships was assayed to estimate heritability (h^2), the proportion of the existing variation that can be attributed to genetic causes and is amenable to change by selection. Estimates of h^2 for several aspects of defensive behavior (*J. Hered.* 1984. 75:135-140) indicated that a sufficient portion of the variation was genetic and that a selection program would be feasible. In addition, the trait was very variable in the population of bees on which the selection would be practiced, a necessary condition for success.

Selection was practiced for three generations beginning with a base population of only Africanized honey bees, 80 colonies established from caught swarms in a highly Africanized area. The 10 most defensive and the 10 least defensive were chosen as parentals for the next generation using the standard field test. The values from the field test were combined into a single value, or selection index. In subsequent generations, more feral colonies were established and tested as controls, and then added to the selected population to increase the available colonies and to reduce inbreeding.

After two generations of selection, significant differences existed between the two lines for time to respond to target, number of bees responding at 90 s and number of stings (see figure). Therefore, the selection program using the standard test to measure colony defense was successful in modifying the undesirable defensiveness. The extent of the success was



The mean number of stings in two 2 cm x 2 cm suede leather targets after 30 s of attack by a defending colony for two selected lines and the feral population controls.

measured by estimating realized heritability; values in the more defensive line ranged from 0.59 to 1.34, in the less defensive line from 0.10 to 0.79. The difference in the magnitude of these estimates indicated that the program was more successful in selecting for more defensive bees than for less defensive bees.

2. Cox, R.L.,[b] W.T. Wilson, D.L. Maki, and A. Stoner.—CHEMICAL CONTROL OF THE HONEY BEE TRACHEAL MITE, *ACARAPIS WOODI*.—Acephate (Orthene®) and dimethoate (Cygon®) were fed at 3ppm a.i. in sugar syrup to field size honey bee colonies for 6 weeks. Colonies were fed *ad libitum* and the old syrup was replaced each week with freshly prepared treatment syrup. Neither compound reduced the mite infestation during the treatment period nor in the 8-week period following treatment. Coumaphos (Perizin®), a chemical used to treat the *Varroa* mite in Europe, was tested in the laboratory and field tests for the control of the tracheal mite. Coumaphos did not reduce significantly the mite population density or infestation level when administered to bees topically or *per os* as a food additive fed *ad libitum* in sucrose syrup.

In two tests, six mite-infested colonies were treated with 50 gram packets of menthol crystals and six colonies left as untreated controls. The crystals vaporized and acted as a fumigant within a bee hive. New menthol packets were placed on the bottom board of each hive every 2 weeks for 6 weeks of continuous exposure. Samples of live worker bees were dissected to remove the prothoracic trachea, identify and count various life stages of the tracheal mite and to determine mite mortality inside the trachea. After two weeks of exposure to menthol vapors, 98% of the adult mites were dead and after three weeks 100% of the mites were dead in the tracheal tubes.

Colony infestation level decreased during both tests regardless of the treatment. We offer no explanation for this phenomenon, but seasonal factors do not account for all of the decrease. A difference in colony infestation level begins to show at 2 weeks after starting menthol treatment and the difference increased until the end of the test. The difference between treated and untreated would be even greater if only bees with live mites were used in calculations.

The population density of mites also decreased in all colonies. However, mite populations from treated colonies decreased more rapidly than controls and eventually reached zero. For example, after 2 weeks of menthol exposure there were no live adult mites found in the trachea but the untreated samples averaged 3.8 live adult mites/bee. The adult mites were affected first, followed by a decrease in the immature mite and egg populations.

Honey bee populations were sometimes adversely affected by exposure to menthol vapors. Dead bee trap counts were about twice as high in the menthol group as in the untreated colonies (197 vs. 107 dead bees/colony/week), yet would fall within the normal range. The data indicate that possibly smaller colonies and higher ambient temperatures are conditions that lead to increased brood and adult mortality.

3. Cox, R. L.,[b] W. T. Wilson and J. O. Moffett—RESIDUES ON FOLIAGE, HONEY BEES AND BEE PRODUCTS FOLLOWING E.C. APPLICATIONS OF ETHYL PARATHION TO COMMERCIAL SUNFLOWERS.—An emulsifiable concentrate of ethyl parathion was applied by aircraft two times to a 40 ha field of commercial sunflowers (*Helianthus annuus*) that was in bloom near Lubbock, Texas in July 1982. The insecticide was applied at 1.1 kg in 28 liters of water per ha. Six standard-size colonies of honey bees (*Apis mellifera*) were located within 50 meters of the edge of the field prior to application. Six additional colonies were placed adjacent to a field of sunflowers (*ca.* 1 ha) that remained untreated. A Todd-dead-bee trap was attached to the entrance of each hive. A modified OAC pollen trap was placed under one-half (3) of the colonies at each location.

The insecticide applications caused serious mortality in adult worker bees. The number of dead bees collected from the dead bee traps next to the treated field were more than 50 times larger than in unexposed control colonies during the first 2 days after the spray was applied. Between the third and fifth days the number of dead bees dropped rapidly. On July 16, the 5th day after the first application, the mortality rate was comparable in exposed and unexposed colonies (45 vs. 46, respectively). In late July, the colonies were transported to northern Colorado and placed in a rural area where few or no insecticides are utilized. Without further pesticide exposure the colonies recovered in adult population and brood production. The colonies stored sufficient honey to winter well.

Parathion residues in dead bees averaged 3.6 ppm the first day and 1.5 ppm the second day after insecticide application. Then, residue levels in dead bees dropped rapidly to only 0.1 ppm by the fifth day.

In bee-collected pollen, the pellets contained 3.7 ppm parathion 3-days after the first application. In all other daily collections the quantity was always below 1 ppm.

The ethyl parathion sprays caused a 96 to 98% reduction in the collection of sunflower pollen and a 73 to 97% reduction in the collection of other species of pollen pellets the first full day after the sprays were applied. Pollen collection was slow to increase because of drastic loss of foraging bees.

Parathion residues on the sunflower leaves varied from 41 to 107 ppm on the first day after spray application to a low of 12 to 20 ppm on the fifth day. These residues were high over several days. There were no honey bees or other species of insects in the field or on the plants for several days. The residue was lower on the sunflower heads, probably because of the greater thickness between the two exposed surfaces when compared to "thin" leaves. This resulted in a dilution due to the greater mass of plant tissue.

No parathion residues were detected in newly stored honey, in recently capped honey, in beeswax or in samples of air collected in the sunflower fields ca. 2 meters above the ground.

4. Danka, R. G.[a,c] — RESPONSES OF AFRICANIZED HONEY BEES TO POLLINATION MANAGEMENT — The rigors of commercial, migratory pollination practices may increase the frequency and severity of the objectionable traits of Africanized honey bees (AHB). Examining these effects is essential to assess the potential impact of AHB on pollination in the United States. This study was conducted to evaluate likely problem areas by comparing AHB to European honey bees (EHB).

Fifteen AHB and 15 EHB colonies were moved (at night, with hive entrances screened and queens left uncaged) six times to different sites during a 2-month test in Venezuela. Colonies remained at the sites (commercial sesame fields, commercial mango and citrus groves, or tracts of tropical dry forest) for periods ranging from three to 14 days. Hot, dry conditions during the test contributed to colony stress. Colonies were inspected thoroughly at each location to determine the status of the queen, worker population, disease and pest problems, and colony handling characteristics (i.e., excessive running, festooning or stinging). A standardized defense test (*Ann. Entomol. Soc. Amer.* 75: 383-387) was used to evaluate defensive responses of each colony on the day following each move. Nectar storage was estimated by colony weight changes at each site. Adult mortality in five colonies of each bee type was monitored with dead bee traps.

More AHB colonies (n=12)than EHB colonies (n=5) were debilitated by moderate to severe population losses. These losses were not classical abscondings, as the queen and some workers typically remained. The colonies which experienced losses were probably unacceptable as pollination units during at least some portion of the test. Population losses variously affected the other responses which were measured.

Differences in defensive responses of the two bee types were less than has been found when colonies were not managed for pollination, but sufficient stinging problems

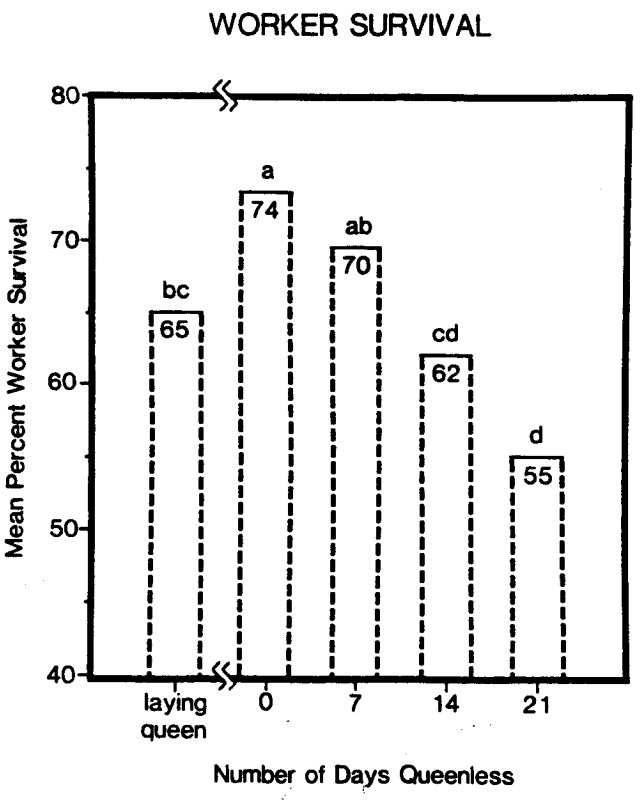
could be expected in a labor-intensive agricultural setting to warrant considerable concern. Compared to the pretest baseline, stinging after movement was often increased in EHB and reduced in AHB. Overall, AHB colonies stung targets 33% more than EHB colonies stung targets. AHB colonies also responded with more flying, harassing bees, while EHB colonies had more crawling bees on the hives.

EHB colonies had greater weight gains than AHB colonies at four of the sites. The bee types lost similar amounts of weight at the other two locations.

Running, festooning, or stinging bees hampered inspections of AHB colonies three times as frequently as inspections of EHB colonies. No differences were found in the number of times requeening was required among the groups of bees ($n_{AHB}=8, n_{EHB}=7$). Locating AHB queens during colony inspections was often difficult and time consuming. There were no significant pest or disease problems, and swarming was never initiated in any of the colonies. Adult mortality was usually higher among the EHB colonies.

Generally, the simulated pollination program resulted in smaller bee-type differences than expected for most potential problem areas. However, it is likely that under less harsh conditions response differences would be greater. The tendencies of AHB colonies to suffer population losses, to defend the nest excessively, to be difficult to inspect, and to store honey poorly make managing these bees for commercial pollination an unattractive prospect.

5. Delaplane, K. S.[c] and J. R. Harbo — EFFECT OF QUEENLESSNESS ON WORKER SURVIVAL, HONEY GAIN AND DEFENSE BEHAVIOR —The effect of queenlessness on worker honey bees was tested with 50 colonies in groups of 10 (5 treatments and 2 replicates) in August, October, December 1984, February, and April 1985, in Baton Rouge, Louisiana. The 10 colonies in each group were all from a single heterogeneous mixture of bees, and each colony began with a known population size (about 6,000 workers) and no brood. Colonies were placed 20-50 meters apart and about ½ kilometer from the nearest apiary. The 5 treatments were each 28 days long and consisted of (1) queen caged for 9 days; queen laying for 19 days (control); (2) queen caged for 28 days, queenless for 0 days; (3) queen caged for 21 days, queenless for 7 days; (4) queen caged for 14 days, queenless for 14 days; and (5) queen caged for 7 days, queenless for 21 days.



Effect of queenlessness on the survival of adult worker bees in newly established colonies. Colonies started with no brood and the experiment ended before any adults emerged from the laying queen treatment. Percent worker survival was the number of workers in the final population (after 28 days) divided by the number in the initial population. Means with different letters are different at the 0.05 level.

At the end of the 28-day period, colonies were checked for the number of bees, the weight gain of the combs, stinging behavior, amount of brood, and worker drift. Worker drift was checked to confirm results for survival. A paint color was assigned to each colony on day 5 (all colonies still had caged queens at this point), and 300 bees from each colony were marked. During the final examinations, bees of nonresident color were noted.

Among treatments 2-5 that never had a laying queen or worker brood, prolonged queenlessness caused decreases in worker survival (see figure), colony weight gain, and defense behavior (number of stings). Few workers (36/15,000 marked bees) changed their residence to other colonies. This low incidence of drifting showed that the results depended on treatments and were not affected by workers being attracted away from queenless colonies.

6. Dietz, A.[d] and R. Krell — SURVEY FOR HONEY BEES AT DIFFERENT ALTITUDES IN KENYA— The introduction of *Apis mellifera scutellata* into South America has seriously affected not only beekeeping, but also the general public. On the continent of its origin, *A. m. scutellata* shares East Africa with several other subspecies in more or less overlapping populations. *Apis mellifera monticola* is one of the subspecies which is separated from *A. m. scutellata* by ecological rather than geographical barriers. *A. m. monticola* has been collected in the Tanzanian mountains at 2,400-3,100 m altitude in forest regions with night frost. Ruttner (1981) reports the presence of *A. m. monticola* also for the lower altitude regions of Kenya. An intermediate type of bees, in appearance similar to hybrids of *A. m. monticola* with *A. m. scutellata*, was found at an altitude of 1,500-2,400 m (Rinderer, per comm.).

A. m. monticola, a gentle, large bee, and perhaps a good honey producer (Rinderer, per comm.), appears to have more desirable traits for beekeeping than its temperamental neighbor, *Apis mellifera scutellata*. It is assumed that *A. m. monticola* has maintained its purity, except for some hybridization in the immediate contact zone, and has prevented the invasion of aggressive *A. m. scutellata* into its territory. Therefore, it may provide important clues for breeding European bees resistant to hybridization with Africanized bees in Central and North America. The purpose of this survey was to determine the distribution of *A. m. monticola* and to identify suitable breeding stock.

Our survey included the collection of honey bee samples from feral and managed colonies, as well as composite bee samples from roadside flowers. The bees were obtained from 30 roadside locations, 42 Kenya Topbar hives (KT), 21 rustic log hives (RL), and 4 feral colonies (1 in the ground and 3 in trees).

The locations surveyed ranged from 3,500' to 11,000' in altitude and dry acacia savanna to mountain rain forest. It is very difficult to find colonies at high elevations (8,000' to 11,000'). Most colonies were sampled between 5,000' to 7,000'. There was a wide variation of behavior in response to disturbance, ranging from very gentle to extremely aggressive. Most colonies sampled were aggressive to very aggressive, especially those located at the lower elevations (5,000' to 7,000'). Black and yellow bees were encountered at all elevations.

The bees in the Kimbo Research Apiary (GK), near Meru

at 8,500', were fairly aggressive when collected from the entrance of KT hives without smoke. When inspected with smoke at sunset on another day, we encountered a greater variation in behavior. Some colonies were rather gentle, while others were very aggressive; however, population sizes varied considerably.

All other colonies surveyed at Mt. Elgon (4,000'-6,000'), Elgon and Kimilili district, were aggressive to very aggressive and persistent in pursuing us after colony inspections. The bees collected near Mt. Kenya had a wider range of behavior and fluctuated from almost gentle to very aggressive. In both areas (at lower elevations), the temperatures were considerably higher and some bees near Mt. Kenya were working on a slight nectar flow.

The defensive behavior of bees from a training apiary near Nairobi, and from very aggressive colonies encountered near Mt. Elgon and Mt. Kenya, was very pronounced and very similar to that of many aggressive colonies examined by us during our research in Brazil and Argentina.

Colonies examined at more than 8,000' elevation appeared gentler than most bees at lower elevations. However, a number of factors such as temperature, colony size, etc., may have had a strong influence on this behavior. Therefore it may not be prudent at this time to generalize about any change in aggressiveness in bees following an elevation incline, or a change of habitat. Once the identity of the samples is known, the correlation may become stronger.

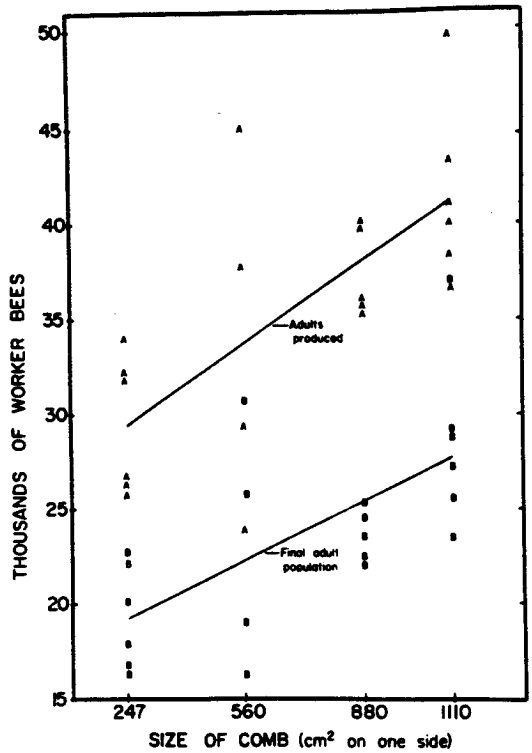
As far as the correlation between elevation and the type of bee is concerned, the 30 composite bee samples obtained from roadside flowers, 11 of which were collected above 7,000', should further clarify the situation. Additional conclusions can then be formulated about behavior, distribution, interbreeding, and possible reasons for interbreeding or failure to interbreed.

7. Eischen, F.A.,[d] C. Vergara, and A. Dietz. — APITOL, A NEW SYSTEMIC ACARICIDE FOR THE CONTROL OF *ACARAPIS WOODI*. — The epidemic of *Acarapis Woodi* in northeastern Mexico is expanding and adverse effects are indicated. Preliminary results with Apitol® (Ciba-Geigy) show good control when it is fed in sucrose solutions. Bee longevity and hoarding were normal at effective doses.

8. Harbo, J. R.[a] — MANAGEMENT OF FIELD COLONIES FOR GENETIC SELECTION OF HONEY BEES — The purpose of this work was to design field colonies that would be well suited for comparing stocks and for selecting genetic characters in honey bees. Previous work showed that the number of bees, the amount of comb, and the volume of the hive are all variables that affect population growth and honey production and thus must be controlled. When comparing colonies with 2300, 4500, 9000, 17000, and 35000 bees; a population of 9000 bees was best overall (*J. Apic. Res.* 25:22-29). Populations of 9000 bees were then compared at different degrees of crowding (100, 200, 300, or 500 bees per liter of hive space). The most crowded bees produced the most honey and had the shortest life span; those at 200 bees per liter produced the most brood.

This report presents data on the effect of comb size. Colonies with the largest combs produced more brood and had more adult workers at the end of the 59 day experiment than colonies with the two smallest-sized combs ($P<0.05$)(see figure). Moreover, studies using instrumentally inseminated or naturally mated queens in colonies with small or large combs showed that small combs diminished differences in the rate of egg laying, differences that were present when large combs were used. Therefore, it is not only important for combs in all colonies to be the same size during testing, it is important for them to be large.

The study of comb size completed the work to develop a field colony for genetic selection of honey bees. Based on all the data, field tests began with Langstroth-sized hives, each with 9,000 bees, 7 combs (each 21 x 43 cm), and a queen to be tested.



Effect of comb size on the population growth of honey bees. All colonies started with no brood, 9000 workers, and a naturally mated queen. Colonies differed in comb size (13 X 19, 13 X 43, 21 X 43, or 26 X 43 cm) but had the same comb surface area and hive space. The test period was March 15 —May 13, a period of maximum colony growth in Louisiana. A = the number of adult bees produced during the 59-day test period. No adults emerged during the first 20 days, so the values represent adults emerging from day 20 to day 59. Equation for line A: Y = 25961 = 13.6X, $r = 0.71$, $n = 21$. B = the number of adults in the colonies at the end of the experiment (day 59). Equation for line B: Y = 16794 = 9.7X, $r = 0.66$, $n = 21$.

9. Hellmich, R. L.[a] — MATING EUROPEAN HONEY-BEE QUEENS TO EUROPEAN DRONES IN AREAS WITH AFRICANIZED BEES. — Beekeepers in Africanized areas need a reliable, inexpensive source of European queens in order to requeen Africanized colonies. European queens that are produced in these areas usually are not acceptable because they mate predominantly with Africanized drones. The objective of this research is to provide information on drone saturation technology. This technology, combined with semi-isolated mating apiaries, can be used to produce European queens that mate predominantly with European drones in Africanized areas.

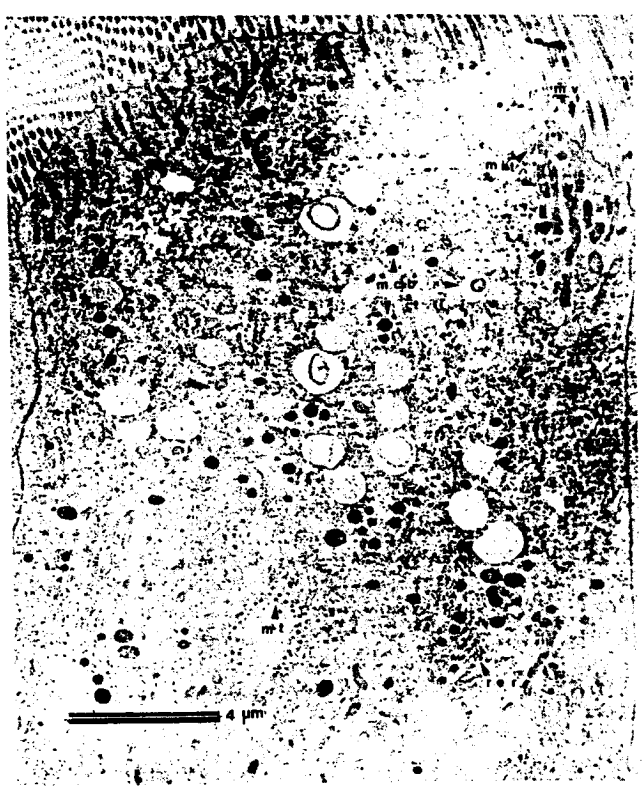
In Venezuela, 30-40% of European queen matings were controlled in an apiary which had only four to seven European drone colonies. Workers produced by the mated queens were compared to hybrid and European workers. These standards were produced by instrumentally inseminating European queens with semen from either Africanized or European drones. The number of Africanized drones which potentially had access to the queens from the experimental apiary was equivalent to the number of drones flying from approximately ten European drone colonies (drone-colony equivalents; $DCE = P_h/P_e \times D$ where P_h = average percentage of hybrid progeny, P_e = average percentage of European progeny, and D = number of European drone colonies). If the DCE measure of feral drones for an apiary is known, then matings can be controlled at predictable levels. Control is accomplished by supplying a mating apiary with a sufficient number of European drone colonies (see Table 1). Clearly some of the colony numbers shown in the table are not operationally realistic; however, others are. Relatively few European drone colonies are required in an apiary to attain

low levels of mismating in areas that are semi-isolated (*i.e.* areas with low DCE values). Queens produced from such a management scheme should be marketable in many areas of South and Central America where European queens are not available.

Table—Approximate Number of European drone colonies necessary to control matings of European queens when Africanized drone-colony equivalents (DCE) range from 0.01 to 20.0. The estimated DCE for a mating apiary in Venezuela was 10.

	DCE						
Percentage of Matings Controlled	0.01	0.1	0.5	1.0	5.0	10.0	20.0
10						1	2
20					1	3	5
30					2	4	9
40					3	7	13
50				1	5	10	20
60				2	8	15	30
70			1	2	12	23	47
80			2	4	20	40	80
90			5	9	45	90	180
95		2	10	19	95	190	380
99		10	50	99	495	990	1980
99.9	10	100	500	999	4995	9990	19,980

10. Jimenez, D. R.[c] and M. Gilliam. — ULTRASTRUCTURE AND CYTOCHEMICAL LOCALIZATION OF CATALASE AND L—(ALPHA)—HYDROXY ACID OXIDASE IN MICROBODIES OF HONEY BEE MIDGUT — The ultrastructural location of catalase and L-(alpha)-hydroxy acid oxidase (HAO) was determined in the ventricular epithelium of 5-day-old worker honey bees. Catalase-positive reaction product occured in apical supranuclear cytoplasm of mature columnar epithelial cells and was evenly distributed throughout the ventriculus but decreased in the immature cells of the regenerative nidus. It was localized in spherical to ovoid bodies, 0.2-2.0 μm in diameter. The smaller bodies (0.2-0.8 μm) exhibited a dense outer ring surrounding an electron lucid core. Development of the mature microbody resulted in enlargement to the full diameter of 1.5-2.0 μm and the dispersion of catalase reaction product as a diffuse granular matrix or as a concentric ring within the limiting tripartite membrane. HAO occurred within the same cellular organelle and had a similar developmental sequence. The enzyme complex appeared to be intimately associated with the interior wall of the microbody as a small (0.2-0.4 μm) multilaminate sphere, or when the microbody expanded, as an intricate part of the membrane. Oxidase activity resulted in reaction product deposition when intact tissue was supplied with glycolic, lactic, isobutyric, or isocaproic acid. Early cytochemical work by other researchers demonstrated high concentrations of divalent cations within similar particles and suggested a secretory function. We hypothesize that the microbodies are microperoxisomes involved in intracellular catabolism in the midgut. This is the first ultrastructural demonstration of microperoxisomes in honey bee midgut, although they have been intensively studied in mammals and some invertebrates.



Mature columnar epithelial cell showing catalase-postive reaction product as small dense microbodies and as diffuse matrix within larger mature bodies (rer = rough endoplasmic reticulum, mit = mitochondria, mv = microvilli, mcb = microbodies, mt = microtubules.).

11. Krell, R.[d] — A MODEL FOR ESTIMATING POLLINATOR EFFICIENCY AND POLLINATION REQUIREMENTS — A study of honey bees on Gallberry (*Ilex glabra*) showed a characteristic correlation between certain foraging behavior and the size of nectar rewards encountered by the foragers. A weak positive correlation existed between reward size and number of flowers visited per minute. A stronger negative correlation was found between reward size and the FFC (Krell and Dietz 1985). The FFC (forage flight coefficient) is calculated by dividing the largest possible distance between any two points of a forager's path by the length of time for which this foraging flight has been observed.

The FFC will allow an estimate of reward size without having to measure nectar content of flowers. The number of flowers visited per minute can either be deduced from the reward size or from actual counts in the field. If the average crop load of a returning forager is known, the length of a forage flight can be calculated. To calculate the total possible number of forage flights per day and per forager with the above information, one has to assume that rewards remain the same all day and that a forager will collect all day at the same rate. If one assumes that each flower will be visited only once, one can deduct the maximum number of flowers that can be visited by one forager per day. After counting the number of flowers to be pollinated in a certain area, a total need of pollinating foragers can be assessed.

Once this basic relationship is established, modifications can be introduced in order to increase the accuracy of this model. For example, there will be a certain percentage of flower revisits which will be influenced by forager density and by the nectar secretion characteristics of the flowering species. These influences also affect the FFC and are partially deductable from it. The percentage of flower revisits and other factors will increase the number of foragers needed for pollination (*i.e.*, honey bees do not forage at the same rate all day, rewards change during the day, certain species need revisits for optimum seed set and fruit development etc.). Most of these influences can be corrected for by measuring the FFC at various times over the course of a day. The number of foragers needed in this model for nectar foragers is reduced by the number of pollen foragers and other pollinators in the field and the life time of a flower, if longer than one day. However, the presence of pollen foragers and other pollinators may often be negligible. The distance between colony and flowers and the reward size will influence crop load in a predictable manner. Weather and flower shape and accessability will also predictably influence the need for foragers.

Mean fluoride concentration of live adult bees was different between locations. Highest amounts of fluoride were found at the FH location (219 ppm) and lowest at Prosser (11 ppm) with the REC and VRF locations intermediate. Mean fluoride concentration of dead bees was significantly different between locations though there were no differences between live and dead bees at the four locations. Fluoride was found in stored pollen in the lowest level at Prosser (8 ppm) and the highest at FH (37 ppm). Fluoride levels in honey varied from 0.3 ppm (Prosser) to 1.2 ppm (FH).

The average adult bee and brood population data were summed to a monthly mean. In general, all colonies developed normal-sized adult and brood populations with no striking consistent differences detected between locations. The number of dead bees found appeared normal and there were no significant differences between locations. In 1984, significant differences were detected in brood survival between locations though the differences were not related to areas of fluoride concentration. No differences were detected in 1985 or 1986. Brood population dynamics indicated the percent of individuals in different stages of development approximated a bell-shaped curve and no consistent differences were evident between locations or time of year of sampling. In 1984, no significant differences were evident between locations in honey production and the colonies at VRF produced the most honey. In 1985 and 1986, the colonies at Prosser produced the most honey followed by those at FH, REC, and VRF.

Data collected during this study show fluoride is present in honey bees, stored pollen and honey at different levels, depending on location of the colonies in relation to a fluoride point source. Our data show that these concentrations of fluoride are not a factor in bee mortality, colony vigor, or honey production.

15. Moffett, J.O.,[b] D.J. Banks, and R.M. Pittman — FLORAL VISITS BY HONEY BEES TO THREE CAGED PEANUT GENOTYPES AND THE RESULTING INCREASE IN HYBRID SEED — In 1982, three peanut genotypes, *Arachis hypogea* L., were grown under 6 Saran® cages at the Oklahoma Agricultural Experiment Farm at Perkins to determine how honey bees, *Apis mellifera* L., would visit peanut flowers in cages. The increase in hybrid seed resulting from these floral visits also was determined.

Twenty-one plants (7/genotype) were planted as a double 3 x 3 Latin Square with the last 3 plants added on the end of each of the 3.66 x 7.32 x 2.44 meter cages. Identical plantings were made in 6 uncaged field (check) plots which were interspersed among the caged plots. Each genotype, "Krinkleleaf" (P151), "Narrowleaf" (P105Y), and "Yellowflower" (US 98Y), contained a dominant genetic marker so that the 6 possible crosses could be separated visually when plants were grown from this seed.

A strong nucleus containing at least 3 frames of brood was kept in each cage continuously from the onset of bloom until it was too late in the year for mature seed to be produced by the flowers that opened.

Inside the cages, more than 3 times as many bees made floral visits to the "Yellowflower" genotype as to either the "Narrowleaf" or "Krinkleleaf" genotype (904, 284, and 252 visits respectively). The bees averaged moving between genotypes every 5th (19.8%) floral visit and flew to different plants of the same genotype on 6.8% of their visits. This amount of bee movement among genotypes should be adequate to effectively transfer peanut pollen among cultivars if it can be successfully transferred by honey bees.

The bees started visiting the flowers when they opened, or about 7:30 a.m. on sunny days. Bee visits peaked between 8:30 and 9:30 a.m., and then gradually declined on the 6 warm days of the 9 days between August 2 and September 3 when observations were made. During these hot days the flowers closed by mid-afternoon. During the 3 cool damp days, the bee visits peaked at 11:00 a.m., 1:00 p.m., and 4:00 p.m. On the cool days the flowers both opened later and stayed open later than on the warm days. Overall, the honey bees visited the peanut flowers moderately well.

The time the bees spent visiting a peanut flower ranged from 1-165 seconds, the average time was 16.1 seconds, the median time 11.0 seconds, the most frequent times 4 and 5 seconds. The bees appeared to collect nectar only. No bees were observed collecting pollen.

All the seeds from the experimental plants were collected in the fall and planted the following spring to determine the percent of hybridization. Because flowers of the genotypes studied are highly cleistogamous (self-fertilizing before the flower opens), hybridization was low. Sixty-two of the 7540 plants (0.82%) grown from the seed collected from plants grown under the cages with bees were hybrids. This was 3 times more than from the check plots where 20 of the 7171 plants that grew were hybrids (0.28%).

Pollen from the "Yellowflower" genotype was the male parent for more than three times as much seed as the other two genotypes (35 vs 12 for "Krinkleleaf" and 22 for "Narrowleaf" pollen).

Normally, bee visits to peanut flowers at the Perkins Farm are low. During this study no bees were observed visiting the flowers in the uncaged (check) plots. However, megachilid and halactid bees have sometimes been seen visiting other peanut flowers on this farm.

Honey bees could be used as pollen vectors, at least in cages, in the production of hybrid peanut seed if male sterility can be achieved in peanuts by the use of cytoplasmic male sterility, genetics, chemicals, or other methods.

16. Moffett, J.O.,[b] J. Harvey, & R. Cox — PENNCAP—M TOXIC TO HONEY BEES FIVE HOURS AFTER APPLICATION — Adding an experimental sticker did not markedly reduce the toxicity of either Furadan® (carbofuran) or Penncap-M® (a microencapsulated formulation of methyl parathion) to honey bees. These insecticides were sprayed before 9:30 a.m. by air to fields of flowering alfalfa on both July 28 and Aug. 4, 1983. The insecticides were applied at a rate of 1.1 kg AI/ha in 18.7 liters of spray mixture per application to fields located in Southwestern Oklahoma. All these colonies survived, but most were reduced to 2-3 frames of bees and brood.

In a related study all 5 of the colonies moved to the edge of a field 5 hours after the last application of Penncap-M died. During the 1st week after the bees were moved to the field, an average of 13,836 dead bees per colony were collected from the dead bee traps and bottom boards. Almost all the bees in the colonies were killed. Five colonies were also moved next to the field sprayed with both Penncap-M and the sticker 5 hours after the last spray application. These colonies suffered moderate damage. An average of 1,544 dead bees/colony were collected the 1st week after their exposure to the combined sticker-Penncap-M spray. This was only 11% as many dead bees as were lost by the colonies exposed to the Penncap-M spray that did not contain the sticker. Dead bees collected the morning after the bees had been moved into the Penncap-M sprayed fields contained 3× as much parathion residue (2.50 ppm) as dead bees collected from colonies exposed to the combined sticker-Penncap-M spray (0.76 ppm).

Overall residues of carbofuran from the colonies and fields exposed to 2 sprays of Furadan in declining order of magnitude were alfalfa foliage 873, pollen 15, dead bees 6, and honey 1. Residues of parathion from the Penncap-M exposed colonies and fields in declining order of magnitude were alfalfa foliage 356, pollen 21, dead bees 1, and honey 0.

Details of this study are documented in an article by the authors. (*J. Entoml. Sci.* 21:294-300,1986)